

Oceanography

Parc
sses



- As we know, our earth's crust is comprised of the lithosphere(continental plate) and oceanic plate.
- The following are the difference between the oceanic and continental plates:
- The oceanic plate is made up of heavier material dominated basalt rocks and Gabbro rock(iron and magnesium)** as compared to the lithosphere plate dominated by granite rocks(Silicon, Aluminium).
- The oceanic plate is much thinner than the continental plate.
- The oceanic plate is much younger(less than 200 million years) than the continental plate (more than 1 billion years).
- The oceanic plate is made up of divergent boundaries; upwelling magma from the mid-oceanic ridge and it subducts near continents.

What is Oceanography?

- In Oceanography we study the physical and biological components of the ocean including ocean waves and current. The following study includes,
- Configuration of ocean
- Bottom topography of the ocean
- Different Marine landforms
- Marine resources
- Temperature, salinity, wave, tidal wave
- Wave energy
- Marine pollution

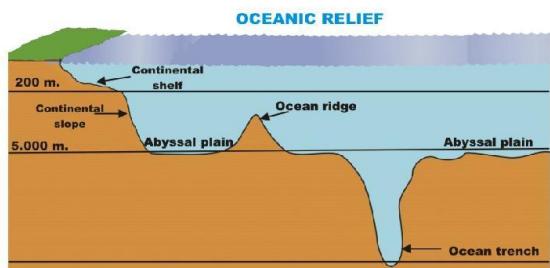
What is oceanology?

- National Centre for Polar and Ocean Research**
- Headquarters: Vasco da Gama
- Founded: 25 May 1998
- Director: M. Ravichandran
- The **National Institute of Ocean Technology** was established in November 1993 as an autonomous society under the Ministry of Earth Sciences, Government of India. NIOT is managed by a Governing Council and the Director is the head of the Institute. The institute is based in Chennai

The scientific study of all components of the ocean including the cause and consequence of these components is called oceanology.

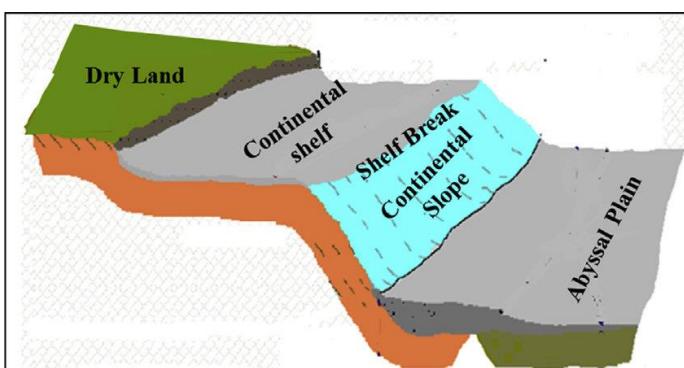
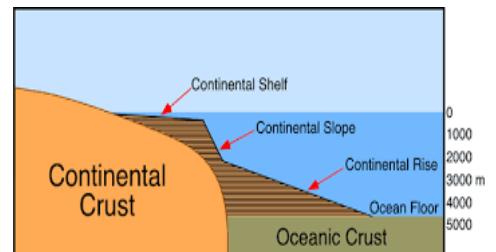


- The ocean floor may be divided into three major divisions based on depth as well as relief. Three major divisions are:
- Continental Margin
- Deep-Sea basins or Abyssal plains
- Mid Ocean ridges



Continental margin:

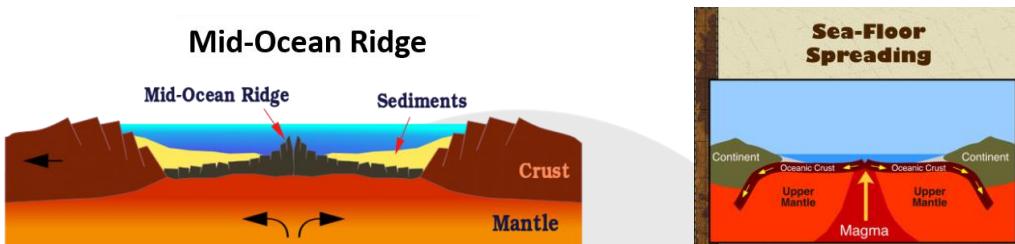
- It lies between continents shore and deep-sea basins.
- It includes:
 - Continental shelf
 - Continental slope
 - Continental rise
 - Deep Ocean trenches



- **Continental shelf:**
- It is an extended margin of each continent occupied by shallow seawater.
- The shelf ends with a very steep slope called the shelf break.
- The width of the continental shelf varies from ocean to ocean and continents to continents, but the average width is approx 80 km.
- largest shelf width having 1500 km is the Siberian shelf in Arctic ocean.
- Contents shelf covered with various sediments of a different period that are brought by river, glaciers, winds from land and distributed by waves and current.
- Massive sediments received over longer times because of the sources of fossil fuels.

- **The shelf is formed mainly due to**
 - submergence of a part of a continent
 - relative rise in sea level
 - Sedimentary deposits brought down by rivers
- **There are various types of shelves based on different sediments of terrestrial origin –**
 - glaciated shelf (Surrounding Greenland),
 - coral reef shelf (Queensland, Australia),
 - shelf of a large river (Around Nile Delta),
 - shelf with dendritic valleys (At the Mouth of Hudson River)
 - shelf along young mountain ranges (Shelves between Hawaiian Islands).

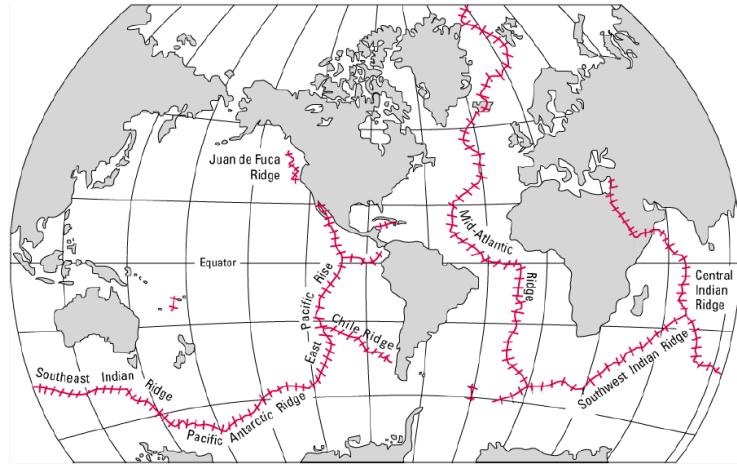
- **Continental slope:**
- The Continental slope connects the continental shelf and ocean basin.
- It starts with the steep slope of the continental shelf.
- Continental slope boundary indicates the end of continents.
- Canyons and trenches are found in this region
- **Continental rise:**
- Continental rise lies between the continental slope and abyssal plains. It is made up of sediments that come from the continental shelf.



- **Deep-sea basin or Abyssal plains:**
- It is extended plains that lie between the continental margin and mid-oceanic ridges.
- Some fine grains sediments such as clay and silt from the continental margin also get accumulated in these areas.
- It covers nearly 40% of the ocean floor.
- **Mid-Oceanic ridges:**
- It is interconnected chains of mountain systems within the ocean.
- It is the largest mountain chain of the earth that is submerged under oceanic water.
- Central rift systems called Crest. Intensive volcanic activities experienced in the rift systems at the crest.

Oceanic Deeps or Trenches

- The trenches are relatively steep sided, narrow basins (Depressions). These areas are the deepest parts of the oceans.
- They are of tectonic origin and are formed during ocean – ocean convergence and ocean continent convergence.
- They are some 3-5 km deeper than the surrounding ocean floor.
- The Mariana Trench off the Guam Islands in the Pacific Ocean is the deepest trench with, a depth of more than 11 kilometres.
- They are associated with active volcanoes and strong earthquakes (Deep Focus Earthquakes like in Japan). This makes them very significant in the study of plate movements.
- As many as 57 deeps have been explored so far; of which 32 are in the Pacific Ocean; 19 in the Atlantic Ocean and 6 in the Indian Ocean.



Bottom Topography Of The Atlantic Ocean



- The Atlantic ocean is the second largest ocean after the Pacific ocean and it is approx 50% of the Pacific areas. It is named after the Atlas mountain of Morocco, Africa.
- North America and Europe, and South America and Africa were united in the geological past. Wegener also proofed it.
- Due to a tectonic rift around 200 million years ago and Atlantic ocean is created between them.
- At present, North America is moving in the northwestern direction and Europe is moving in the southeast direction.
- At present, the Atlantic ocean is spreading at a rate of approx 4cm per year.

• **Mid-Atlantic Ridges:**

- It is nearly the middle of the Atlantic ocean starting from Norwegian basic via Iceland in the north to approx 58 degrees south latitudes.
- Approximately length is 1600 km

• **Seamounts and islands:**

- Fico Islands of Azores
- Gape Verde Islands
- Canary Islands
- Newfoundland



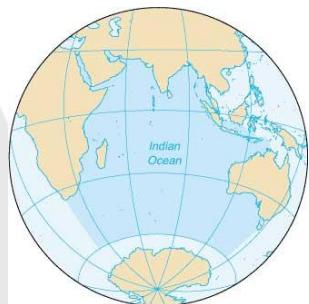
Extra Info:

- It's shape resembles the letter 'S'.
- there are coral islands like Bermuda and volcanic islands like, St Helena
- The Atlantic Ocean has numerous marginal seas occurring on the shelves, like the Hudson Bay, the Baltic Sea, and the North Sea, and beyond the shelves like the Gulf of Florida (Mexican Gulf).



Bottom Topography Of The Indian Ocean

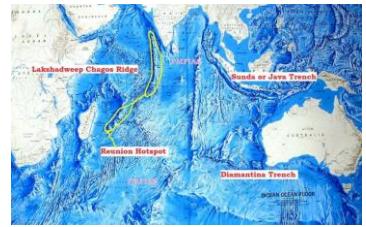
- The Indian Ocean is the only ocean that is named after the Country that's India.
- It is the third-largest after the Pacific and Atlantic oceans.
- In the geologically past, India, Australia, Madagascar, Africa were united.
- Due to the geological rift between the African Plate and the Indian Australian Plate, the Indian Ocean starts spreading.
- Later about 80 Million years ago, the Indian Plate separated from the Australian plate and 90 degrees Indian oceanic ridge created.



Major Islands in The Indian Oceans:

- Seychelles
- Mauritius
- Reunion Island
- Madagascar
- Lakshadweep islands group
- Maldives
- Sri Lanka
- Andaman and Nicobars
- Cocos Islands

- Trenches in the Indian Ocean:
- Sunda Trenches(Deepest in the Indian ocean)
- Dia Martina Trench



Bottom Topography Of The Pacific Ocean

- The exact time of the development of the Pacific ocean is not known, but it may have developed around 250 million years back after the breaking of Pangaea.
- It is the largest Ocean among the five covered 1/3rd areas of the earth's crust.
- It is triangular in shape.
- Having the Largest extensive Abyssal plains with average deep of 4500 meters.
- It has the largest number of Islands around more than 2000.
- Having the deepest trench that is Mariana Trench around 11000 meters deep.
- Pacific Ring of Fire, the world's largest area of volcanos and earthquake hot spots, the unique feature of the Pacific Ocean.



- Seamount and islands:
- Japanese
- Philippines
- Indonesia
- New Zealand
- Fiji
- Hawaiian Islands

Temperature Of The Oceans

- Sources of Ocean water temperature:
- Surface Water gets heat from Sun and temperature gets diffused or reached depth due to convection.
- Bottom water gets heat from volcanos activities in oceanic ridges areas.

Measurement of Oceanic temperature:

- Bathythermograph is used to measure the temperature of ocean depth.
- The temperature of the Ocean Surface is measured by Satellites by a macro wave Radiometer.
- The process of cooling and heating of ocean water is slower as compared to land as Sun rays penetrate more in water than land and water molecules diffuse the energy more quickly than land.

• **The following factors affect the temperature distribution of the ocean water:**

- Latitude
- Unequal distribution of land and water
- Prevailing Winds
- Ocean Current
- Enclosed sea

• **Latitude:**

- The amount of Insolation (exposure to the sun's rays) get decreases from the equator to the poles and thus the temperature of surface water get decreases from the equator to the poles.

• **Unequal distribution of land and water:**

- Water gets heats indirectly from land and as the northern hemispheres have more lands as compared to the southern hemisphere; Northern hemisphere water is warmer than southern hemisphere ocean water.

• **Prevailing Winds:**

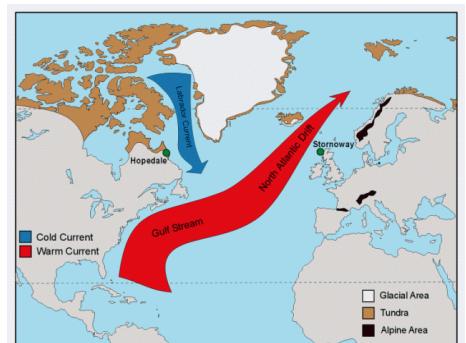
- Winds blowing from lands to ocean water drive warm water aways from the coast that leads to the upwelling of water from below leads to a longitudinal distribution of ocean water.

• **Enclosed sea:**

- In the lower latitude, the Enclosed sea has a relatively higher temperature than the open sea.
- In the higher latitude, the enclosed sea has lower temperatures than the open or surrounding sea

• **Ocean Current:**

- Warm ocean current increases the temperature in cold areas. For example, the North Atlantic ocean drift current or Gulf Stream current increases the temperature in western Europe
- Cold ocean currents decrease the temperature in warm areas. For example, the Labrador current decreases the temperature on the North East coast of North America.



Horizontal Distribution Of The Ocean Temperature:

- The average temperature of the surface temperature of tropical water is around 27 degrees C.
 - The gradual decrease of temperature experiences from the equator to the poles.
 - **The highest temperature is not recorded at the equator because of the following reasons:**
 - Dense clouds formation in the equatorial region reduces the sun's heat.
 - The Equator gets convection rainfall all over the years, hence increase the fresh water in the equatorial region. As freshwater has relatively cooler than saltwater.
 - Equatorial rivers such as Amazon and the African river add huge freshwater to the ocean.
-
- The rate of decrease of temperature with increasing latitude is generally 0.5 degrees C per latitude.
 - The highest temperature is recorded slightly north of the equators.
 - The northern hemisphere ocean has relatively more temperature than southern ocean waters as land is more extensively found in the northern hemisphere.

SALINITY OF THE OCEANS

- The salinity of the ocean's water can be measured as the total salt contains in the 1000 grams of seawater. If dissolved salt is more than 24.7 grams per 1000 grams of water.
- **The following factors affecting the ocean salinity:**
- The salinity of surface water depends mainly on evaporation and precipitation.
- In the coastal regions, surface ocean salinity greatly influences by the fresh inflow of water from rivers.
- In the polar region, it greatly affects the freezing of the ice.
- Winds also transfer sea salinity to other parts.
- Ocean current also contributes to salinity variations.

Horizontal distribution of Salinity:

- Any changes in the temperature and density of water reflect the salinity of the ocean.
- Normal ocean salinity is generally between 33 to 37.
- In the landlock such as the Red sea, it is recorded 41 due to higher evaporation.
- Estuaries and Arctic sea, it fluctuates between 0 to 35.
- In the hot and dry regions where the evaporation of water is high, it may reach 70.

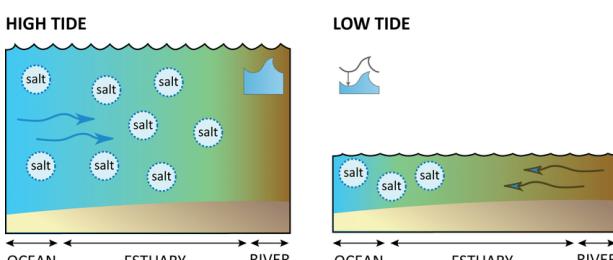
- In the Pacific Ocean:
- North Western Pacific, salinity decrease from 35 to 31 because of the fresh influx of melted water from the Arctic ocean.
- In the southern Pacific, salinity also decreases due to the fresh influx of melted water from Antarctica.

- Atlantic Ocean:
- Salinity is around 36.
- Baltic sea records low salinity due to the influx of river water by a large quantity.
- In the Mediterranean sea, very high salinity was recorded due to higher evaporation.
- Very low salinity is recorded in the Black sea due to the higher influx of river water

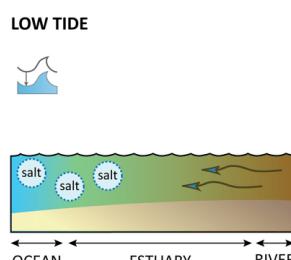
- Indian Ocean:
- The average salinity is 35.
- Low Salinity is recorded in the Bay of Bengal due to the high influx of river water.
- High Salinity is recorded in the Arabian Sea due to the low influx of fresh water in the Arabian Sea.

Vertical Distribution of Salinity:

- Location and depth of the ocean, both matter for salinity.
- Salinity at the surface get decreases by freshwater input or get increase by loss of water to evaporation and Ice.
- Salinity in the depth is very much fixed as there is no water adds or loss.
- Salinity generally increases with an increase in depth.
- There is a distinct zone called Halocline, in this zone, there is a sharp increase of salinity.
- An increase in salinity causes an increase in density



the tide pushes ocean water into the estuary
ocean water enters the estuary and the salinity increases
the depth increases in the estuary



the tide pulls water from the estuary to the ocean and freshwater enters the estuary
more freshwater enters the estuary and salinity decreases
the depth decreases in the estuary

Highest salinity in water bodies
Lake Van in Turkey ($330^{\circ}/_{\text{oo}}$),
Dead Sea ($238^{\circ}/_{\text{oo}}$),
Great Salt Lake ($220^{\circ}/_{\text{oo}}$)

Table 13.4 : Dissolved Salts in Sea Water
(gm of Salt per kg of Water)

Chlorine	18.97
Sodium	10.47
Sulphate	2.65
Magnesium	1.28
Calcium	0.41
Potassium	0.38
Bicarbonate	0.14
Bromine	0.06
Borate	0.02
Strontium	0.01

- Effects of salinity:
- It affects ocean circulation:
- High saline water is heavier in nature and they sink. Coldwater is also heavier and sinks at the poles.
- Ocean water from the bottom moves from the poles to the equator. Surface water moves from the equator to the poles.
- Biodiversity:
- Ocean water is heavier than fresh water and that enables plankton to float on the water surface. Without plankton, the entire ocean ecosystem will collapse,



Parcham Classes